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A NOVEL APPROACH FOR PROCURING MEDICAL PARAMETER

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ABSTRACT

This paper describes a novel approach for procuring glucose in saliva. Saliva is one of the most abundant secretions in the human body and its collection is noninvasive. To substantiate the role of saliva as a diagnostic tool, we compared saliva samples with blood glucose. If glucose in saliva is linked to glucose in blood it can be used to detect diabetes mellitus. With the help of glucose oxidase method using enzymatic kit GOD-POD, glucose oxidase and peroxidase the quantitative estimation of blood and saliva glucose level is performed. The correlation between fasting saliva glucose and fasting blood glucose is obtained. The values obtained between the blood and saliva glucose are found distinctly different between normal and diabetic patient. So, with the help of amount of glucose present in saliva we can conclude that whether the patient is diabetic or normal.

KEYWORDS: Non-invasive, Saliva Glucose, Blood Glucose, Diabetes Mellitus.

1. INTRODUCTION

According to the American Diabetes Association, there are two types of Diabetes mellitus means type 1 and type 2. The patient with the type 1 diabetes are insulin deficient and they are dependent on the insulin for their survival and the patient with the type 2 diabetes are insulin resistant means patients body can produce insulin but it is not that much which human body require. Diagnosis and treatment of diabetes require tight monitoring glucose levels, thus a Simple, sensitive and efficient approach for glucose measurement is mandatory.

The International Diabetes Federation had estimated that 382 million people worldwide has diabetes in 2013, and the number would be increase to 592 million by 2035 [4]. There were 5.1 million diabetes-related deaths globally in 2013, equaling to one death every 6 s, an 11% increase over 2011 [5]. Early diagnosis, on-time treatment and continuous management are vital to patients' life quality and to avoid complications such as kidney failure, circulatory problems, heart disease, blindness and stroke [6, 7].

The most commonly procedure used to diagnose the diabetes mellitus is blood extraction which is invasive, painful and discomfort to the patients. The saliva gives advantage over blood is, it is non-invasive, painless and cost effective. There is no special equipment is needed for the collection of saliva. The diagnosis of disease through saliva is easy for the children and adults, since the collection of saliva has fewer complications than collection of blood from body. The significant amount of glucose level is present in saliva only in diabetic condition. The reason is, mammalian salivary glands are highly resistant to the passage of the glucose from their blood into the secretion. The correlation between the blood and salivary glucose is diabetic patient contain glucose in saliva whereas the non-diabetic patient do not contain glucose in saliva.

Apart from saliva, other body fluids are also present which are tears, sweat and urine through which glucose levels can be monitored, However, the composition of these fluids is not uniform between person to person or for same person during different time of the day and external conditions. Also, extraction of tears is by far not entirely a non-invasive technique as it requires procedures which are cumbersome and at times it is inconvenient to the patient. While saliva is considered more suitable option for non-invasive measurements due to easy in extraction as compared to tears and sweat and considering that measurement of alcohol, lactate and glucose have been measured successfully in saliva. Therefore, if fresh saliva is drawn for analysis each time, it can prove more significant for non-invasive monitoring of body metabolites.

There are different methods are there to measure the glucose by using sensor such as Near infra-red, Mid infra-red, Raman Spectroscopy and much more. In this study we approach to make it simple through the image processing without using any sensor.

In this study the initial step is to collect saliva samples from different diabetic and non-diabetic patients, minimum amount of 1ml sample is to be collected & also the blood glucose level is checked. In order to measure the glucose in saliva we used saliva sample and GOP-POD solution. Now the mixture of both is scanned by the scanner. That scanned image is given to the MATLAB as input image. By doing image processing on the input image the amount of glucose present in saliva is displayed on the GUI and compared the blood glucose and saliva glucose values in Microsoft Excel software.

2. MATERIAL AND METHODS

This study was conducted in K-lab Homeopathic clinic. The fifty patients are randomly selected for this study. A detailed history of each patient is obtained regarding their Age, Sex, Duration of the Diabetes. The quantitative estimation FSG, Fasting Saliva Glucose and FPG, Fasting Plasma Glucose was done by glucose oxidase method using enzymatic kit GOD-POD, Glucose Oxidase and Peroxidase.

The criteria to distribute individual in the categories is

Criteria	Group 1	Group 2	Group 3
	Healthy	Controlled Diabetes	Uncontrolled Diabetes
Fasting Plasma Glucose (mg/dl)	<120	<140	>140

2.1 Saliva Collection

The patients were given the detailed information about collection of the saliva. The patients were instructed to rinse there mouth with distilled water before the collection of saliva. Saliva was collected in clean sterile containers by spitting method.

2.2 Materials

The office scanner (officejet pro 6830 e-All-in-1) was from HP India Ltd., commercial glucometer (Accuchek Active) was procured from Roche India Ltd. Filter paper (Whatman no. 1).

2.2.1 Materials Provided

1. Glucose Reagent (1000 ml)
2. Distilled Water
3. Glucose Standard (100 mg/dl)
4. Buffer Reagent (10 ml)

2.2.2 Materials Required But Not Provided

1. Accurate pipetting devices
2. Test tubes/rack
3. Timer
4. Heating block
5. Micro-pincher

2.4 GOD-POD Reagent Preparation:

Add 2.5ml of buffer regent (L2) to 250ml distilled water or demineralised water. Empty the content of one bottle of glucose reagent (L1) in it. Mix by gentle swirling or inversion. Do not shake vigorously. Allow to stand at room temperature for 30 minutes. This working reagent is stable for 60 days when stored at 2-8˚C.

2.5 Quantitative Determination of Glucose

Principle of method:-

In this Glucose is oxidised to gluconate and hydrogen peroxide in the presence of glucose oxidase reagent. After that Hydrogen peroxide reacts with phenol and 4-aminoantipyrine by the catalytic action of peroxidise to form a red coloured quinoneimine dye complex. Intensity of the colour formed is directly proportional to the amount of glucose present in the saliva sample.

$$Glucose + O_2 + H_2O \xrightarrow{Glucose\ Oxidase} Gluconate + H_2O_2$$

$$H_2O_2 + 4\text{-}Aminoantipyrine + Phenol \xrightarrow{Peroxidase} Red\ Quinoneimine\ dye + H_2O$$

3. RESULT AND DISCUSSION

In the present study we tried to determine the amount Glucose levels in the body and diagnosing diabetes mellitus by using saliva. The glucose GOD-POD method was used in this study. This method prevents repeatedly pricking of the skin and will not cause calluses in the skin. After scanning the liquid mixture of god-pod with the saliva of diabetic and non diabetic patients in a scanner we found a proportionality constant. According to the proportionality constant we determined a graphical relation between the salivary glucose and blood glucose of diabetic patient. The proportionality constant which we find is 1200 between the blood glucose and saliva glucose. Because as we are going to find the amount of the red component present in the saliva then by setting the values of other two primary colour, blue and green to zero and detected only the red part.

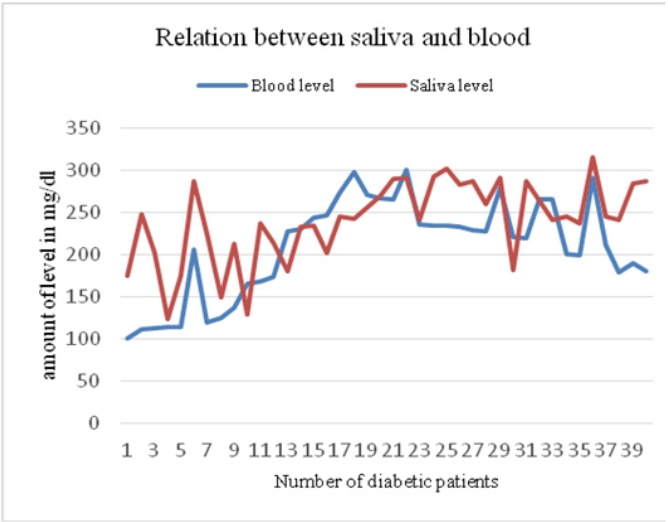
For finding the proportionality constant we developed a GUI platform in MATLAB 2013 software. In this initially, the original image was converted into YCbCr image of scanned saliva sample. Then the threshold levels of RGB model were determined using the YCbCr method. After determining the threshold levels, all the scanned images were compared to the threshold level.

The image was processed into red masked image that is a negative image of all red colour pixels present in the original image. Further in the program the three primary colours present in the image were differentiated and their masked images were observed.

On the GUI the red component present in saliva as given below:-

This GUI shows us about the diabetic person salivary glucose analysis. The patient has blood glucose of 180 mg/dl which was checked by Accucheck and by using our process it is 0.23983. Hence by multiplying with various proportionality constant for the better accuracy we found out the proportionality constant which is 1200. By multiplying the saliva glucose with 1200 value we get 177.47 mg/dl. This result analysis is only for the diabetic patients and for the non- diabetic person the there is no glucose or less amount of glucose is present in the saliva.

The graph shown below gives the information about the saliva glucose also increases approximately with the level of blood glucose. The saliva level was determined by the amount of red colour components in the scanned image of the solution.



4. CONCLUSION AND FUTURE SCOPE

In this present study we have approached the topic salivary glucose detection to make it non-invasive and painless by using the image processing. The amount of red component present in the saliva after doing GOD-POD process. By using this methods we got a relation between the saliva and blood glucose level. The proportionality constant which we found in blood glucose and saliva glucose is 740 and for the Non-diabetic person glucose in the saliva is in less amount or negligible. Hence the color of the mixture do not change.

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